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A Cyberfeminist Utopia?

Perceptions of Gender and Computer Science among Malaysian Women Computer Science Students and Faculty

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The low and shrinking numbers of women in higher computer science education is a well-known problem in most Western countries. The dominant Western perception of the relationship between gender and computer science codes the latter as "masculine," and the low number of women is seen at least partly as an effect of that coding. Malaysia represents a different case. There are large numbers of women in computer science, and computer science is not perceived as "masculine." Rather, it is deemed as providing suitable jobs and good careers for women. This reflects an understanding of gender where femininities are constructed by association to office work, commonly recognized as a woman-friendly space because it is seen as more safe and protected than, for example, construction sites and factories. The findings suggest that gender and computer science may be more diversely coproduced than commonly believed in Western research.

Keywords: *computer science; gender; technofeminism; cyberfeminism; cyborg feminism*

Much research has explored the gender-technology relationship to analyze how women have been excluded from technological fields and how gendered perceptions and values have worked to shape design as well as use of technologies. A common claim across an otherwise diverse body of research has been that this exclusion has been produced through a strong relationship between technoscience and men's performance of masculinities (Cockburn 1983, 1985; Cockburn and Ormrod 1993; Faulkner 2000; Fergus 1993; Hacker 1989, 1990; Lie 1998; Mellström 1995; Robinson and McIlwee 1991; Wajcman 1991, 2004). An exclusion focus has also dominated studies of the gendering of computer science, which have primarily explained the

low and declining number of women in higher computer science education in most Western countries through two types of deficit models (Lagesen 2005, 14-18): women's deficits (e.g., Brosnan 1998; Borge et al. 1980; Durndell et al. 2000; Kramer and Lehman 1990; Maccoby and Jacklin 1974; Siann 1997) and deficits in the educational practices of computer science and its student culture (e.g., Cohoon 2002, 2006; Gabbert and Meeker 2002; Lagesen 2005; Margolis and Fisher 2002; Roberts, Kassiandou, and Irani 2002; Townsend 2002). Furthermore, discriminatory practices and other minority problems have been identified as produced within the culture of computer science (e.g., Dambrot et al. 1985; Spertus 1991; Teague 2000). Finally, the image of computer science has been viewed as "masculine" and thus prone to exclude women (e.g., Corneliussen 2002; Edwards 1990; Henwood 2000; Kvande and Rasmussen 1989; Mörtberg 1987; Stepulevage and Plumeridge 1998; Wright 1996).

The weakness of this kind of negative-critical analysis is illuminated when we encounter the case of Malaysia. Here, women constitute about half of all students in higher computer science education (Lagesen 2005; Ng 1999; Othman and Latih 2006). Thus, the exclusion thesis appears quite misplaced. When so few Western women study computer science, the palpable question is, how come many Malaysian women do? This article aims to explore *how* the Malaysian situation is different by analyzing how Malaysian women reasoned about their decision to study computer science—not to *explain* the difference between their decision-making and that of Western women. Why did Malaysian women make this choice? Did they see computer science as gendered, and if so, in what way?

Because of the exclusion dominance in previous research, we know little about why the few Western women who actually study computer science do so. In a North American context, Margolis and Fisher characterized women computer science students as the "survivors of the 'boy's club' of high school computing" (2002, 49). They were skilled and interested in the technical aspects of computing and derived pleasure from logical thinking. A major influence was parents' careers, interest, and support (see also Teague 2000). Furthermore, Margolis and Fisher observed the importance of "pillars of persistence" like believing in hard work rather than in talent and exercising resistance toward the "male hacker-culture." Similarly, Trauth (2002) found that women who chose to study computer science were a diverse group, exposed to different sociocultural influences and experiences and with different ways to handle their situation. However, they shared being an "odd girl out" as women in a field that was dominated by men and also, by implication, looked upon as a "masculine." What, then, happens when women are not a minority in computer science as is the case in Malaysia?

Cyberfeminism, Cyborg Feminism, and Technofeminism

The large proportion of women studying computer science in Malaysia challenges the way Western feminist research has theorized the gender-technology relationship in terms of exclusion. Do we need to understand this relationship in a different way, or does previous Western research still offer fruitful frames of analysis? Is the Malaysian situation less utopian than one could believe?

Judy Wajcman's (2004) recent review of research on gender and technoscience outlines four different frames of analysis, covering the main theoretical positions in this field today. Can they work as accounting resources to understand the high number of women in computer science in Malaysia?

The first frame, "technoscience reconfigured," represents the initial feminist effort to analyze the gender-technology relationship. A main achievement was the transformation of studies of technoscience from gender-blind to gender-aware (Cockburn 1983, 1985). While celebrating the importance of this research in shaping feminist perceptions of technoscience, Wajcman notes several weaknesses of this frame, above all its tendency toward essentialism.

The second frame has emerged under the label of *cyberfeminism* (see, e.g., Flanagan and Booth 2002; Hawthorne and Klein 1999; Bell and Kennedy 2000; Kirkup et al. 2000; Reiche and Kuni 2004). The term encompasses a range of approaches to analyze the relationship between information and communication technologies (ICT) and gender, which claim to observe progress of women in new technological arenas such as the World Wide Web (Kennedy 2000). While contributions designated or proclaimed to be cyberfeminist are diverse, they share an optimism concerning women's computer-based activities, above all related to the use of the Internet and net-based ways of communicating (Kennedy 2000; Wajcman 2004; see also Woodfield 2000).

While most cyberfeminists do not deny that there are processes that tend to exclude women (Hawthorne and Klein 1999; Spender 1995), they also see that many women have become highly motivated and skilled cybercitizens (see, e.g., Wakeford 2003). Sadie Plant (1996) offers perhaps the most prominent and optimistic cyberfeminist visions. Women, computers, virtual reality, and cyberspace, she argues, are linked together in dispersed, distributed connections—the matrix, which, because of its inherent feminine character, will emerge as the new society that will destroy patriarchy. However, Plant's visions have been criticized for essentialism, lacking critical perspective, hyping new technologies, and overstating the women-friendliness of cyberspace

(Adam 1997; Hawthorne and Klein 1999; Pohl 1997; Squire 1999; van Zoonen 2002; Wajcman 2004).

A related, more pragmatic program of cyberfeminism has been called "the communicative turn" in the use of computers. It suggests that communicative aspects of computer technologies are important to make women interested (Nordli 2001; Silverstone and Sørensen 2005). From this perspective, women are expected to engage with the technology in a way that transcends the role of users, finding particular pleasure in the communication possibilities (Rasmussen and Håpnes 2003).

The third frame is based on Donna Haraway's (1985, 2004) figure of the cyborg, an implosion of human and machine. This perspective suggests a focus on disruptions and ambiguities in relation to gender and technology. It advocates the exploration of the women-computing relationship, while paying particular attention to the complexities and contradictions of this relationship. Wajcman (2004, 127) acknowledges Haraway's sensitivity to the cyborg's ambiguous nature. Still, she criticizes cyborg feminism as well as cyberfeminism for assigning too much agency to new technology and not enough to feminist politics.

To amend this problem, Wajcman (2004) introduces the fourth frame of analysis, technofeminism. It emphasizes the need to investigate the gendering of new technologies to assess critically how technologies are shaped in ways detrimental to women. Technofeminism relies on feminist political practices in combination with feminist research to change sociotechnical networks to include more women. According to Wajcman, this is needed, because the culture of computing is still "predominantly the culture of white American males" (2004, p. 112). Wajcman, nevertheless, sees opportunities for women to be attracted to technoscientific spheres when "entry does not entail co-option into a world of patriarchal values and behaviour" (2004, p. 112). Moreover, she asserts that an increase in the number of women in engineering eventually will dismantle the strong relationship between hegemonic masculinity and the culture of engineering. This latter argument suggests that quantity is vital to change-gendered practices, cultures, and symbols, implying that computer science may, in fact, be gendered differently in Malaysia (see Lagesen 2007; Sørensen and Berg 1987).

These four frames have to be used critically when analyzing women computer science students in a non-Western country like Malaysia since they may represent Western points of view with respect to women and technology (see Mohanty 2002; Ong 1995; Stivens 2000). Thus, when I draw on these frames as accounting resources in the analysis, I can also examine some of their underlying assumptions. For this purpose, Malaysia may be a critical

case. Using the first frame, technoscience reconsidered, the expectation would be that Malaysian women get excluded or marginalized within computer science. The second frame, cyberfeminism, would suggest that Malaysian women students consider communication a major attraction of new computer technologies, using this as a way to succeed as computer scientists. The cyborg feminist frame invites a focus on the potentially ambiguous gains of studying computer science, while the technofeminist frame suggests that feminist politics or women's struggles are essential in achieving a large proportion of women students in computer science. Moreover, all four frames presuppose that computer science would be gendered and that this would be apparent from the accounts of my informants.

Malaysia—Women and Modernization

I started my research by looking for places where the number of female and male students in computer science would be roughly equal. The rationale was to explore the implications of such a situation with respect to perceptions of gender and computer science. The University of Malaya (UM) was selected as my field site. It is a large public university situated in the capital, Kuala Lumpur. The Faculty of Computer Science and Information Technology (FSKTM) was established in the mid-1990s. In 2001, women constituted 52 percent of the bachelor's students in computer science and 65 percent in information technology at FSKTM. Forty-three percent of the master's students, and 39 percent of the PhD students were women. While this may look like a shrinking pipeline pattern, one has to consider that many of the male PhD students actually were non-Malaysians. The majority of the faculty, as well as all heads of departments and the dean, were women. This seems a representative picture of the gender pattern in computer science education for the whole of Malaysia for the past ten years (Othman and Latih 2006).

Two particular aspects of the Malaysian society should be mentioned here. First, ICT has been a government priority area fueled by the rapid economic growth in Malaysia. It has been seen as a key to a better future, and the authorities have strongly encouraged young people to study IT for the past fifteen years (Ng 1999, p. 144). Second, the official quota system privileges indigenous Malays. It provides them with benefits in most official areas, such as quota protection in education, scholarships, employment, training, trade, business permits, and so on. This gives them advantages in relation to the other large ethnic groups in Malaysia, Chinese (about 30 percent) and Indians (about 10 percent). The government created the program to correct interethnic

economic imbalances among the ethnic groups, but it is a sensitive and controversial issue (Chee-Beng 1997; Luke 2002; Mellström 2003; Ng 1999).

Malaysian women constitute a diverse group in terms of ethnicity, religion, class, and regional cultures, including urban/rural differences as well as cultural variations within the ethnic groups (Chee-Beng 1997; Oorjitham 1984). Thus, one should be careful about making general claims. Education, however, has played a key role in the swift modernization process and has been instrumental in promoting "national unity" (Mellström 2003; Stivens 2000). The government made particular efforts to remedy women's previously disadvantageous educational position through a state-sponsored, large-scale entry of women into mass education and industry (Ong 1995; Yun 1984). Stivens (2000) argues that the high number of women in Malaysian higher education shows that parents value education for daughters as much as for sons. Moreover, women play an increasingly important role as political and religious actors, and they also engage with regional and global feminism (Ong 1995; Stivens 2000).

Ong asserts that Malay women have been made icons of modernity by two competing institutions working to form different postcolonial nationalisms: the government and the Islamic resurgence. State-driven programs dictated a series of tasks for women, for instance, to raise children with values such as efficiency and self-reliance. "The official discourse on the modern family thus defined women's modern roles: as working daughters who could pull their families out of 'backwardness' and as housewives (serirumah) who could inculcate 'progressive' values in their children" (1995, p. 394). This family model supported a more assertive role for women at home, raised the expectations for women, and granted them new freedoms (Lie and Lund 1994; Ong 1995). However, the Islamic revivalism of the late 1970s and the early 1980s produced a countermodel, in which the Islamic discourse (*dakwa*) suggested that women should not compete with men in the labor market. Jobs that involved serving others—for example, as clerks, teachers, and nurses or doctors (attending women and children only)—were preferred (Ong 1995). However, the *dakwa* has become much less prominent since the mid-1980s.

A common feature of the state-driven modernity discourse and the *dakwa* is the centrality of women's role as mothers and wives. Nevertheless, there is a potential conflict between the image of the relatively free and emancipated working woman and the domesticated, compliant, modest Muslim woman.

According to Nagata and Salaff (1996), this has intensified the ambivalence of Malay women seeking professional careers, and it inhibits a potential common sentiment of women across ethnic lines. Both Chinese Malaysian

and Indian Malaysian women belong to religions (Hinduism), cultures, and moral systems (Confucianism) that are potentially paternalistic and may suppress women's autonomy (Armstrong 1996; Mellström 2003; Oorjitham 1984; Peng 1984). However, Chinese as well as Indian Malaysians recognize the importance of higher education, perhaps because of their disadvantaged situations as non-*bumiputeras* (Chee-Beng 1997; Mellström 2003). Also, the Malaysian state programs' focus on education and progress has probably influenced all ethnic groups in Malaysia. A study of student attitudes towards learning to use the Internet found no ethnic or gender differences, suggesting a fairly evenly distributed interest toward ICTs among ethnic groups (Hong, Ridzuan, and Kuek 2003).

Method

Data were collected at UM in 2001. I interviewed twenty female students at FSKTM. Eleven were undergraduates, and nine were master's students who also worked as tutors. In addition, I interviewed three heads of departments, the dean, one female lecturer, and two male master's students. All informants found it acceptable to be interviewed in English.

I got in touch with interviewees through one of the master's students who were asked to help me to meet others. Using so-called snowball sampling, I reached more potential informants through other students. Generally, people were willing to be interviewed. The interviews took place in different locations on campus.

The interviews have been transcribed and analyzed according to the main tenets of grounded theory (Corbin and Strauss 1990), emphasizing the method of constant comparison across the empirical data (Glaser and Strauss 1968). In the presentation, illustrative quotes from the interviews have been provided, often showing the dialogue that took place between me and my informants. To let readers make their own interpretations, the dialogue has been reproduced close to the original transcriptions.

The female students I interviewed were of different ethnic origins: eight were Chinese Malaysian; three were Indian Malaysian; and the rest, including faculty and the two male students, were Malay. Ethnicity is indicated by names. Indian students have names that begin with an *I*. Chinese students have American or Chinese names, and the rest of the names is Malay.

My informants varied in terms of age, year of study, and social background. Since my research questions are analytical-explorative, I consider the set of informants to be adequate even if it is not statistically representative. Although

ethnic aspects play an important role in a wider discussion of female students in Malaysia, not least because of the *bumiputera* politics (see, e.g., Luke 2002), this is not used as an accounting resource in the article. Rather, the analysis focuses on what the informants say about themselves and how they describe their choice of computer science, in line with the tenets of micro-sociological, interactionist approaches. It is not an inquiry into aspects of the wider Malaysian culture.

Consequently, context will be invoked only when the informants themselves address it in their accounts, mainly through stories about personal experiences and background. The selection has been made to provide a diversity of voices in relation to the research questions. Also, in my analysis, the content of the concepts of *masculine* and *feminine* are seen as continuously produced through my informants' account and not as having any pregiven meaning. Thus, I use quotation marks with these concepts consistently throughout this article.

Becoming Students of Computer Science

Most of my informants did not consider their choice of computer science as special and as something that women in general would not consider. Rather, they saw their choice as consistent with being women. The informants offered quite varied narratives about their decisions. Two aspects emerged as particularly prominent: enthusiasm and instrumentalism concerning computing and computer science. To understand the variations in the gender–computer science relationship, we need to explore in detail how the women reasoned around their choice of computer science. What was the role of enthusiasm relative to instrumentalism, and how did my informants account for these motives?

Enthusiasm

Most of the research that has investigated enthusiasm toward technology has looked at men and the way they find pleasure in tinkering with technology, including computers (Hacker 1989, 1990; Kleif and Faulkner 2002; Mellström 1995, 2003; Turkle 1984). Computer enthusiasm among girls or women has been linked to communication or graphic design and information retrieval (Rasmussen and Håpnes 2003; Kennedy 2000; Plant 1996). However, it has also been shown to emerge from technological aspects, including a fascination for programming (Berg 2000; Corneliussen 2002;

Nordli 2003). Margolis and Fisher found that enjoyment of computing was the factor most frequently mentioned among female students as their reason to major in computer science. However, this interest went beyond technical aspects. It was made meaningful only by invoking human and social contexts (2002, 52). Thus, we have three different ideas of where women would find enthusiasm for computers: in human communication, technical aspects, or social utility. Were my Malaysian informants enthusiastic about computers, and if so, for what reasons?

Actually, quite a few of the women were clearly interested in computers. Some of them had even developed a profound fascination and decided to study computer science when they were still in school, like Salina:

V: So, why did you choose to study computer science?
Salina: Maybe because I'm very interested, actually since I was in form 1. [Standard 1-6 is primary school; form 1 to form 5 is secondary and higher secondary school.] I used to sit and tell my mum: "I am going to be a system analyst, or I'm going to be someone who is an expert in computers."
V: What interests you about it?
Salina: Maybe because the computer did something . . . it's a machine and then . . . we have to operate that . . . I don't know . . . I just like it very much!! (laughing)
V: Did you have any experience with the computers when you were younger?
Salina: Yes, at my primary school . . . I used to learn basic programming, when I am in standard 3 or 4, I think. I used to go to the class every week!

Salina was very enthusiastic. Salina also described the general atmosphere in her class as very positive toward computer science. She had no notion of computer science as a "boy thing." In her class of fifty-fifty boys and girls, everybody enjoyed computing.

V: Did people enjoy computer science or computer subjects in general?
Salina: Yeah. And for me, I enjoyed it very much.
V: And the other girls?
Salina: Yes, they enjoyed it very much too. Because our computer teacher—she is so kind and very generous. She would sit besides us and say, "This is like this, and this is like this, okay?" (Laughing)

Clearly, Salina perceived her female teacher as a role model, associating computer science with her generous and careful guidance. This inspired Salina to want to become a computer science teacher.

There were also informants who had been fascinated with computers because they could be programmed to do things beyond imagination. For

example, Haifa, who since the age of twelve, had wanted to make a robot that could do all kind of things, including housework: "I wanted to do a machine that can do any job . . . at that time I was twelve years old. I don't know the name of that machine, now I know, that machine is called robot. So, I'm very interested to think about how to make life easier." Haifa had completed a bachelor's degree four years ago. Now she was married with three children and wanted to pursue a master's degree in artificial intelligence.

Yin Sung was another enthusiastic computer student working on her master's degree. She had also been introduced to computers as a child and had wanted to become a computer scientist since then: "I wanted to join this computer science mostly because of my dad. I went to Pittsburgh for two years. . . . My dad was doing his master's there. It was very near Carnegie Mellon, the top computer school in the world. So I was really . . . my mom took courses there, so I was very aspired to become a computer scientists. I was very young at the time, around 7 or 8 only. But I remember it very well."

The interest in computers was quite often combined with an enthusiasm for studying computer science because of good job prospects. Computer science was seen as a path to secure well-paying jobs. Also, many of the enthusiastic women had been encouraged by their parents, particularly fathers, to study IT.

Clearly, these women shared an enthusiasm for computers and computer science; some had even developed this interest quite early. However, contrary to the cyberfeminist assumption, the enthusiasm was not related to communication and networks. It was mainly related to the understanding of computers and the ability to manage them, even if the capability of communication or graphic design was mentioned as well. It was also interesting to note how most of these women combined enthusiasm with accounts that emphasized how computer science was a sensible choice in terms of a future career and how they took advice from parents and other family very seriously. In a way, it was a win-win situation. What they wanted to do was sensible and what their parents advised them to choose. Computer science did not represent any break with paternalism, perhaps rather the opposite.

Instrumentality

A large group of my informants had chosen computer science largely for instrumental reasons. They had made it their first choice mainly because of good job prospects and career opportunities. Many had also been strongly encouraged by their parents. For example, Indrani, who was in her third and final year in the bachelor's program. She originally wanted to become a

veterinarian, but her father had talked her out of that and suggested computer science instead:

> Indrani: Actually, when I wanted to come into the university, I wanted to study veterinary science. . . . But then my father was a bit against it, because he said it is difficult for girls to go in that line in Malaysia. So I had to agree with him. . . . So, actually, my father suggested for me to do IT or computer science. I was a bit interested in computers also. . . .
> V: What was your father's argument for you to study computer science?
> Indrani: He said that there is a lot of job opportunities coming up. . . . He told me, "You can have your master's and PhD, and you can earn enough money for your master's and PhD." I said like, "All right." I am glad he told me.

Clearly, Indrani paid a lot of attention to her father's advice. She said she wanted to respect his wishes because of appreciation for him and what he had done for her. The norm about following parents' suggestions or request about educational choice was widespread. Ah Ling started to study computer science because she "obeyed" her father, as she said in a humoristic tone:

> Hmm . . . it's a long story (laughter). Like, I told you, right, that I like sociology. I like psychology. Actually, these were my first choices for my undergrad. But because my dad, he is a teacher, and he is quite realistic, so he says that if I . . . Like, in Malaysia it is not very applicable if I study psychology. He means, [I] cannot gain more money, but this is not true in UK and other countries; it only applies for Malaysia. So, [that is] why my dad says: cannot!! So I just "obey" my dad and take computer science. But that is, at that time, a very famous course. And my brother is also in IT line. So, I think he could help me. So I just . . . take it.

Why were the parents of these women so eager to encourage their daughters to study computer science? One obvious suggestion is the fact that the Malaysian government had been urging people to study IT, particularly during the 1990s. Also, the profound priority given to a conspicuous IT project in Malaysia, like the Multi-media Super Corridor (MSC), was probably an important backdrop of these parents' perceptions of future job opportunities. This was suggested by Supryia. When asked about why she started, she said, "It is because of my father's advice. Because during that time period it was, that was in early in 1990s . . . if I am not mistaken that was in 1993, when the government start[ed] to urge Malaysian people to study IT. And that's what made my father advised me to do so, choose this field, especially IT. So I just follow this advice, and I am quite satisfied in this

field. I want to be a professional in computing, on IT and computer-related fields." Another master's student, Sadaah, had studied marketing in the United States. She had decided to change to computer science because "Malaysia is now turning to technology and computing." Also, she found that too many Malaysians at her U.S. university studied marketing. She wanted to change to IT to be more competitive.

Even if most of the women students I spoke with had been encouraged by their parents, particularly their fathers, there were exceptions. Rafiah, a master's student, came from a small village in the provinces and grew up as the oldest child in a family where no one had higher education and where her family did not highly value having an education. They did not support her decision to take a master's degree. Rafiah was quite troubled when I interviewed her. She felt a pressure from her family to finish her master's so she could start to work and earn money to help with their financial problems. Rafiah wanted to break away from the kind of life her parents lived and find better opportunities through an education and a career.

The obligation and pressure to provide for younger siblings or older retired parents was a recurrent theme among other women students, even if no one else was in Rafiah's situation. It was a consideration that entered their plans for their future. Even first-year students thought about this:

> V: Have any of you thought about doing a master's?
> Sheryl: I think about it, but it depends . . . on my family condition. I have to . . . because have a brother, he is doing engineering courses at the other university, cause there are only two of us in our family. And then my parents are already old, if . . . after three years—because my brother have to study four year in the engineering course—so after three years, if I graduate, I don't work, so *how* should I afford my family, my parents.
> V: What about you?
> Mei Wee: Mostly the same thing as her. Because I'm the oldest, and my father is retiring soon, so after that there will be no income for my family. So, when I graduate, I still have to support my brother, he is quite young.

Even if many of the women had been persuaded or encouraged by their parents to study computer science, most of them found computer science to be an interesting subject. They also acknowledged that the choice to study computer science was sensible and wise because of the good job prospects. However, often the women admitted that with complete freedom, they would have elected something else. But, as Sheryl commented, "Parents always object (laughter) if you want to learn art or music."

An even more severe conflict of interest was evident from the interview with Azizah, a first-year student. She had wanted to study medicine and was not at all happy to end up in the computer science program. She was the youngest and only daughter in her family. Her mother, who had recently died, had wanted her to become a doctor. Since she was not admitted to medicine, her father and brothers had persuaded her to study computer science instead. During the interview, it became clear that Azizah was quite indignant about this persuasion and that she was admitted to computer science instead of medicine. For two years, she had prepared to study medicine, but Azizah found it important to follow her father's wish. However, she was considering studying medicine after completing her computer science degree.

Clearly, it was not easy to go against the family's will in the choice of education. The norm that you should follow your family's/parent's/father's wishes out of love and respect was strong. However, the interview with Azizah also demonstrated her anger of being put in this situation and also her agency, her will to get out of this conflict of interest between herself and her family.

Perceptions of Gender and Computer Science

The absence of gender as an accounting resource in my informants' narratives was striking, compared to the construction of gender and computer science as an amalgam of men/"masculinities" and technologies so prevalent in Western research (see, e.g., Wajcman 1991, 2004). Since men's power mainly seemed to be mediated through the family, the gendering of computer science was different from Wajcman's concept of technofeminism. So how was computer science gendered among my informants?

A general observation was the close link between the perceptions of what was considered "masculine" and "feminine" and the number of men and women in the area. If an area was observed to be dominated by men, it was perceived as "masculine." With a sufficiently large number of women, the field was seen as suitable for women or deemed "feminine." However, other symbolical aspects were also invoked when we discussed gender.

To begin with, computer science was not at all deemed "masculine." Rather, it was described as different from areas that were considered "masculine," like engineering. Dr. Mazliza, a young head of department, put it like this: "I never thought of computer science as a masculine subject. . . . You know, engineering is something that people see as masculine, or geology. But not computer science. I don't see what is masculine about computer science." Computer science was frequently compared to engineering to explain

why it was not seen as masculine. Azizah and Maimunah did this in an interesting and illuminating way:

> Maimunah: You can say that computer science . . . this computer science course is meant to be for women instead of guys. I mean, guys usually go for engineering, architecture, contractors, that kind of jobs.
> V: Why?
> Azizah: Out. Because it is out, not in the office, they're doing outside.
> Maimunah: They get exposed a lot.
> Azizah: Exposed, yeah. More dangerous.
> Maimunah: Except for us, for girls, they expect us to stay in the office, to do that kind of work.

It seemed that the basis to characterize engineering as "masculine" was, in addition to being an area that men often chose, that it required work outdoors. You could be exposed to the sun and to men workers. Computer science, on the other hand, could be considered "feminine" or at least suitable for women because it was associated with office work. It meant working indoors, perhaps mostly with other women. Sadaah, a master's student, formulated it like this: "But in Malaysia, there are many in IT science, many women also enter now. They just like it! Yes. To do technology, right? They want to do more. And if we work with computers, we don't have to go out, right? We can just sit there in the office." The notion that to work indoors was most suitable for women was explained by reference to security, as shown above. Also, gender discrimination in environments dominated by men was perceived as a potential barrier:

> V: What do you consider to be the typical female subject here?
> Mei Wee: Hmm . . . I think office work. Business . . . computer science . . . doctors . . . dentist. Actually there are quite a lot of jobs for women. I think engineering is still a male-dominated area. There are few females in engineering.
> V: Why do you think it is like that?
> Mei Wee: Maybe . . . for engineering, where you have to build buildings, right? And engineers are required to go to the site to check the building constructions, stuff like that . . . because they have to converse with the laborers. And I heard from my friends, they say that, laborers don't really respect women. So, it's better for men to go down to talk to the laborers.
> V: (To Sheryl) You thought about studying engineering. Did you think of it as a "masculine" subject?
> Sheryl: Yes, but I think it is more about civil engineering. Chemical engineering is more to the female side. Because in chemical engineering, most of the time you work in labs, testing the stuff like that. So I think it's quite suitable for

> females also. But for civil engineering, I never thought about that. Because, like she said, we have to go to the site and check out the constructions. Because, I don't like sunlight (laughter). So, you see, I won't choose civil engineering.

Not all types of engineering were seen as "masculine"; chemical engineering was mentioned by many as the most popular choice for women. However, the perception of civil engineering as a clearly "masculine" field seemed widespread (see also Mellström 2003).

Not all specialities within computer science were perceived equally suitable for men and women:

> V: So, did any of you think of computer science to be a predominantly male subject?
> Sheryl: Not really, I think it is quite equal.
> Mei Wee: But maybe on the hardware side it is more males than females, because they have to carry the computer around, with wires and stuff.
> Sheryl: Like network, we have to learn about circuits, electronic circuits; I don't like electronics (laughter).
> V: Is that more of a male subject, you think?
> All: Yeah!
> V: If this is more of the male part of computer science, do you think there are any parts that are more suitable for females?
> Sheryl: I think software engineering and Management Information Systems (MIS) is maybe more suitable for females. Because, software engineering is more to the programming side . . . not so much about physical stuff, you know, the electronic circuits (everyone laughing).

This way of reasoning in relation to gender and computer science was quite common among my informants. Samantha, one of the master's students, maintained that "a lot of boys like networking, but girls like more of theory things." Sheryl put it in a similar way: "Hmm. . . . Among all the four majors, I think software is the best choice. Because networking is . . . I think most the people are guys, because it involves physics, electronics." Setting up networks required traveling to customers, thus raising a security issue as well. However, some women choose to specialize in networks because it is seen as a "masculine" field. Fatimah chose computer networks because it was dominated by men, and she wanted to compete with men. In addition, she did not like reading and the speciality required less reading than other fields. Maimunah was also attracted to networks because of the lack of women in the field: "I think I'm impressed by that, because I can see a woman. Because, usually, I see like a few friends, and my cousin, and they are all guys. The ones that have done networking, they are all guys. I want

to be the first woman in the family, the first." The woman Maimunah referred to was Dr. Mazliza, head of the Networking Department and also quite young. She was an important role model. Fatimah said, "She is very eligible. I had class with her last year, and she is very . . . I would like to be like her!!" Clearly Dr. Mazliza, and also the other heads and the dean, served as role models for the female students. This may explain why so many interviewees wanted to become lecturers in computer science. In fact, nearly all the women I interviewed wanted to become university lecturers. They mentioned several reasons, including the flexible job situation. Some, like Ah Ling, had worked as software engineers in an ICT company:

> Okay. . . . As I told you before, I was a software engineer. We started work at seven o'clock, and we came back from work normally at seven or eight p.m. So, one can say that the whole day is sold to a company. So, that kind of life is not the life that I want . . . that's why I came back to school to do my master course, is to make me become a maybe lecturer at university or colleges. So that's the way to make me have more time, flexi-time to take care of me and my future family.

Sadaah, the only one with a family, had also been working in the ICT industry:

> Sadaah: After I married, before that I like to travel, so after I married, I don't want that, I just want to relax. So, we have a family right, so I don't want to rush anymore (laughing).
> V: But you still want to work?
> Sadaah: Yes, I still want to work. I just want to be a lecturer. So, my husband also says that, better you be a lecturer so you can take care of your family right? You don't have to travel . . . lecturer also travel, but not so much right, so you have to take care of your family, because men always busy right? And then it is nobody to take care of my son. So, I want to be a lecturer.

Less traveling and exposure (compared to working in industry) were important reasons to pursue an academic career. Salina also emphasized that working in the ICT business involved more barriers to women than teaching because of security issues. Women could not stay in the office to work late.

Like in many Western countries, a lot of the Malaysian women students lacked previous experience or knowledge of computing when they entered the program. Interestingly, compared to Western research (e.g., Margolis and Fisher 2002), very few complained about this. Usually, they said that it was just a matter of working hard, and then they would catch up:

> Ah Ling: I told myself; just study hard, study smart, to catch up. So, now I have.

Hard (and smart) work was the preferred strategy to cope with lack of knowledge and experience in computing. Moreover, there was a widespread belief that women worked harder than men. Also the idea that Chinese and Indian students worked harder than Malays was present, but this applied first and foremost to male students.

However, some of the first-year students seemed to think that men were better at programming than women. Indrani mentioned that she saw gender differences in how men and women coped with programming:

> Indrani: The other girls . . . basically, most of the girls don't like programming. Even my friends, when we talk together, we don't like programming, because it is a bit hard for us to understand. And we don't know how guys can understand it better. So . . . but I think, if we just keep on studying it, we tend to understand. I just have to go through it more times. Then I understand.

Thus, the domination and perceived superior competence of men was not considered a real problem and definitively not by the master's students who did not mention such experiences at all. For the female bachelor's students, it became even more important to study hard.

A Different Computer Science?

Perhaps not surprisingly, Malaysia was not a cyberfeminist utopia. There were many women in computer science, but they did not particularly excel in communication, nor did they find their situation unambiguously liberating. Rather, we learnt that there were high demands in terms of efforts, similar to Ong's (1995) and Harris's (2004) observations of the different, difficult, and contradictory expectations toward young women. My informants told they were subjected to numerous demands. Many felt a pressure to sustain their family's finances and to provide for elderly parents as well as younger siblings. Also, the expectation to be an obedient daughter was evident, the costs of which were well illustrated by Aziza's situation. The expectations also included getting married and having children. Most of my informants said they wanted that, but they also wanted to combine having a family with a career. Being a successful career woman was important to them. Thus, in these young women's narratives, there is a mix of individualized and, in a Western sense, "modern" discourses (see Ong 1999 for a critical discussion)

about opportunities and aspirations, as well as more "traditional" family-bound concerns.

How do the findings concur with the four analytical frames discussed previously on the basis of Wajcman's review of main perspectives on gender and technoscience? To begin with, we have observed a coproduction of gender and computer science that appears different, more complex, and less stereotypical than implicated by the main body of Western research.

It is important to note, though, that my informants did not offer spontaneous comments about the relationship of gender and computer science. However, when I asked, they willingly provided gendered accounts, but they were dissimilar to those that dominate Western research. First, computer science was constructed as a discipline well suited for women, not as a masculine recluse. Second, gender was invoked in a different way. Physical activities like working with electronics and mechanical objects were looked upon as "masculine," in contrast to software engineering and programming. The latter were deemed as "theoretical" and thus fitting for women. In fact, a gendered dichotomy of the physical and the theoretical was quite prevalent. Supposedly, women liked theory, while men preferred (and were better at) technical and practical tasks related to the computer.

Thus, there seems to be a complex coding of gender in relation to computer science, mediated by what is perceived as "suitable" for women. This reflects an understanding of gender where women are associated with being indoors and with being protected, and a perception of the office as a woman-friendly place, compared to spaces like construction sites and factories. In contrast to the dominant exclusion focus in the "technoscience revisited" frame, computer science was deemed particularly suitable for women.

Considering the level of enthusiasm among my informants toward a wide range of aspects of computer science, there is also little support for the cyberfeminist belief that communication is women's main preference with respect to computers. The women I interviewed were not particularly enthusiastic about communicative aspects of computer science or other "soft" features. Their objects of fascination included what many Westerners perceive as "masculine" areas, like software engineering, programming, and hardware. Thus, the cyberfeminist frame did not work well as an accounting resource either.

The high proportion of women among Malaysian computer science students was not a result of any technofeminist politics. The national policy that seemed to have influenced the recruitment of women to computer science, in fact, encouraged all young people to study IT. Furthermore, practically all the women I interviewed emphasized that their motivation to

study computer science was linked to their goal of getting a well-paid and secure job. However, from Wajcman's (2004) perspective, it may be appreciated that the larger number of women in computer science in Malaysia seemed to make the culture more welcoming to them.

When analyzing the discourse in the technofeminist frame, the most striking feature was the lack of "masculine" references, in particular the absence of a hacker or computer geek mythology. Also, the women's willingness to invest in hard work and, above all, their belief in the potential of hard work to solve problems, counteracted mythological ideas (see also Margolis and Fisher 2002).

Arguably, it is the cyborg feminism frame that offers the most fruitful theoretical account of my observations, through its emphasis on the ambiguous, complex, and also changeable nature of the gender-technoscience relationship. The frame invites a refusal of a unilateral glorification of technoscience as well as a rejection of it. It is both/and, not either/or. It is inclusion as well as exclusion. To the Malaysian female students, computer science seemed to act like Haraway's (1985) trickster—it offered many new and interesting opportunities of becoming skilled, valued, and important, yet it presented a way of combining empowerment with the acceptance of a paternal system as well as gender differentiating practices that definitely worked in their disfavor.

In this article, I have above all tried to show the complexity of my informants' coproduction of gender and computer science, which—when aligned to Western research—allows greater diversity in understanding the relationship between gender and computer science. In fact, female computer science students in Western institutions may also protest or counter the coding of their discipline as "masculine" (Lagesen 2005). Gansmo, Lagesen, and Sørensen (2003) provide a good example of the dangers inherent in this research. They show how the generalized hacker figure created by social scientists to criticize the problematic effect of a particular form of "masculinity" on computer practices lives on as a myth that young women use as an argument to stay away from computers. The scientific statements we produce about the world may be repercussive. As Haraway (1985) puts it, we have a responsibility for the monsters created by our research, but perhaps even more important, we should try to avoid creating them.

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